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AND NERVOUS DISORDERS

BY

GEORGE T. STEVENS, M. D.

WITH REMARKS

BY AMBROSE L. RANNEY, M. D.

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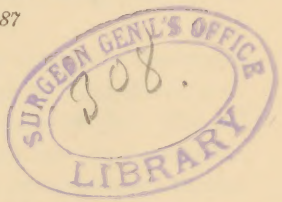

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IRRITATIONS ARISING FROM

THE VISUAL APPARATUS

CONSIDERED AS ELEMENTS IN THE GENESIS OF NEUROSES.*

Two classes of influences are recognized as causes of functional nervous disorders—the more remote or predisposing causes, and those which are immediate. The former, while frequently of insufficient intensity to originate neuroses, may, when the nervous disturbance has been once instituted, be sufficient to perpetuate it for an indefinite time. Immediate causes are, perhaps, rarely of a nature to induce long-continued nervous disorder, and in many instances in which an occasion of disturbance may seem to be clearly indicated by the history of the affection, the influence of the supposed cause may long have passed away, while a pre-existing cause may act in continuing the disorder. This fact can not be too clearly recognized in the study of this class of affections.

It may, for instance, be of little practical importance that a child first manifested symptoms of some severe nervous disorder while under the influence of fright. The evil has been accomplished and the event can not be recalled, nor can such an influence as fright or momentary passion be regarded as permanent or of long continuance. Nor are

* Read before the New York Neurological Society, March 1, 1887.

we to assume some radical disarrangement of nervous action originating from the immediate cause and which perpetuates itself. Such radical disarrangement has not been demonstrated, nor is its existence at all probable.

The hypothesis that there is an underlying cause of disturbance becomes stronger in proportion as we abandon the idea that immediate causes can act as permanent sources of irritation or that a radical disarrangement for nervous action is by such causes induced. Such underlying causes are fully recognized by students of nervous disorders, and their existence is so constantly verified by the daily experience of the members of this society that their importance can not be questioned. Persons in whom such underlying causes exist are said to possess a neuropathic predisposition, and individuals subject to this unfortunate predisposition are liable from trifling immediate causes to suffer from neuroses which manifest themselves in a great variety of ways. Thus one individual will, as a sequel to almost every unusual emotional or intellectual excitement or depression, suffer from headache; another will, with atmospheric changes so slight as to be little regarded by the majority of people, habitually take cold.

It is generally conceded that in a very large proportion of instances this neuropathic tendency is hereditary, but that the predisposition is not necessarily manifested in different generations by the same form of neurosis, nor indeed that in the same individual it is always manifested in an identical manner, but that any one or more than one of a variety of kindred affections may arise as the result of the predisposing tendency.

Anstie, who made special and extensive inquiry respecting this tendency, found that neuralgia, insanity, epilepsy, paralysis, chorea, a tendency to uncontrollable alcoholic excesses, and phthisis were among the group of disorders

which, through hereditary tendency, might manifest themselves either in the same manner or interchangeably.

Of immediate causes of neuroses there is so great a variety that any attempt at enumeration would be futile. Among those familiar to all who hear me may be mentioned the depressed condition of the nervous system after recovery from exanthematous diseases, severe and long continued mental or physical strain, excessive emotional excitements, physical shock, and sudden and extreme changes of temperature. The effect of these and many other exciting causes must, in the nature of the case, be transitory, and, independently of some more permanent influence, can rarely, if ever, account for long-continued, and especially for intermitting, forms of nervous diseases.

Another class of causes should be recognized as exerting marked influence in nervous disorders. This class may be designated as *modifying* tendencies. Among these may be mentioned the influence of vitiated atmosphere, the so-called malaria, the period of life, the performance of certain physiological functions, especially those peculiar to females, and the nature of the employment of the individual. Thus, one subject to recurring headaches, while residing in a malarial region, may find the paroxysms so modified as to resemble attacks of malarial fever. The period of recurrence of migraine or of ordinary headaches is in a considerable number of females governed by the recurrence of certain physiological periods. It is evident that whatever may be the exciting cause of a neurosis, it must, under the great majority of circumstances, be of infinitely less consequence than the influence which leads to it and perpetuates it.

The predisposing influence not only tends to prolong the disorder, but to perpetuate nervous derangements in some form or other, so that when a certain form of com-

plaint is supposed to be cured it very often happens that the subject of disorder becomes the victim of some other nervous disease. So also individuals affected by one form of nervous disorder at one period of life are especially liable to suffer from some other form at another period. Thus, chorea in the majority of instances runs its course in the space of a few weeks, but the person who has been a victim of this affection in early life will be likely to suffer from neuralgia or headaches, and sometimes from epilepsy, in later years. Hence the predisposition is one which is a constant element in the organization of the individual, and may be the same for different forms of disorders; and, moreover, the cure of one complaint may be only the signal for the commencement of another, or, more correctly, the supposed cure of one form of disorder may be only a change in the manner of manifesting a permanent irritation.

We may now inquire whether such a predisposing cause must of necessity be general, pervading the whole organism, or must it necessarily find its seat in the nervous centers, or, finally, may such a predisposing cause be entirely local and outside the great nervous centers? To this question the answer may unhesitatingly be given that the predisposing or irritating cause may be wholly local and confined to any portion of the central or peripheral nervous system. This principle has been too often demonstrated, and is too familiar to those present, to demand any defense. It may not, however, be out of place to remind those to whom the facts are not new of one of Dr. Brown-Séquard's experiments. In enumerating some of the effects of tickling the sole of the foot in a large number of subjects, he speaks, among other things, of laughter, of tears, of jerks of one or both limbs, of a side, or of all the limbs, of tremblings and spasms, while in some instances no effect was manifest.

We are now prepared to inquire whether, inasmuch as

this tendency is transmitted from parent to child, the evil may not consist of some peculiarity of anatomical structure, or of physiological adaptations, which are inconsistent with the most regular and easy performance of the function of a part or parts; and whether certain classes of mechanical peculiarities may not be more than usually liable to become factors of physiological disturbance.

Should we answer these two questions in the affirmative, we assume an hypothesis which, in order to be maintained, must be based upon many and long-continued observations, conducted in a spirit of judicial independence and free from all such bias as might result from occasional and exceptional experiences.

It is my purpose this evening to advance just such an hypothesis, and I hope to be able, while having a just regard for the experiences and teachings of all who have contributed to this important subject, and while avoiding any narrow or exclusive view, to establish the hypothesis in the minds of my hearers. The conclusions which will be announced are based upon observations in more than five thousand cases of nervous diseases in private practice and of a considerable number of cases in public institutions, all of which have been made with as much care and precision as the exacting demands of an active professional life would permit.

That in the course of these observations many cases have failed to receive due attention is undoubtedly true, but that in the general results of this investigation the conclusions reached are legitimate, I think may be affirmed without presumption. In the belief that the neuropathic predisposition must of necessity be the manifestation of many structural peculiarities located in various parts of the organism, any of which may descend from parent to child, but which do not necessarily so descend, and fully appre-

ciating the influence of such immediate and modifying causes as have been already mentioned, the conclusions arrived at in this investigation have been thus stated in a memoir submitted to the Royal Academy of Medicine of Belgium in 1883:

Difficulties attending the functions of accommodating and of adjusting the eyes in the act of vision, or irritations arising from the nerves involved in these processes, are among the most prolific sources of nervous disturbances, and, more frequently than other conditions, constitute a neuropathic tendency.

A doctrine so much at variance with ordinary beliefs must of necessity excite suspicion that the proposition has been based upon insufficient data, or that observations have been imperfectly made. That neither of these suspicions is correct, it is hoped may be shown to the satisfaction of reasonable inquirers. If the proposition appears extreme, and tending at best to the recognition of a single class of causes to the exclusion of others, let me recall the fact that the proposition fully recognizes any and all causes of nervous irritation, and that the influences indicated are held to be pre-eminent but not exclusive permanent causes. If greater importance is conceded to the influences mentioned in the proposition than to others, it is from no unmindfulness of the possibility of other conditions acting as irritating influences, or that certain known or unknown influences may give character to the results of irritation arising from the causes mentioned. Let it be remembered that it has been universally conceded that the nature of the neuropathic tendency is unknown. If one pre-eminently important element is demonstrated, it is not to be rejected because it may not include the whole.

In the explanation of the ætiology and treatment of disease, neither settled theories nor novel doctrines are to be accepted only as they are confirmed by undoubted facts.

Nor can isolated facts, nor facts divested of their natural environments, be accepted as valid evidence in support of theories, old or new. The facts must be uniform, occurring so regularly as sequences as to demonstrate that they are consequences. Unless the skilled observer is able to predict, with a reasonable degree of accuracy, the result of certain combinations of circumstances, such result, when occurring, must be considered accidental. A fair demonstration of such a proposition would demand a wider range of discussion than could be included in a short paper, and I propose to give this evening only the general result of my experience very briefly.

I shall illustrate that experience by relating a few cases, and by exhibiting some photographs, which will show very remarkable changes of physiognomy, such as habitually occur when certain hurtful tensions of the ocular muscles are relieved.

Were it my purpose simply to report the most striking cases of relief from the various serious neuroses which are here represented, there might have been chosen for the most part cases of much more marked success than some of these. The purpose is, however, not to report the most fortunate results, but by these striking contrasts to show, not by words, but by the evidence of photography, the very marked relief which may be expected from removal of certain ocular muscular anomalies.

As the illustrative cases will be confined to those whose photographs are shown, it will be proper to speak first of the photographs in a general way. They are portraits in pairs, the first of each pair having been taken at the commencement of treatment, the second from two to six weeks or rather more later. The average time between them has been about one month.

The portraits are also in two series, the first series rep-

resenting cases in my private practice; the second, cases which were under my care for a short time at the Willard Asylum for the Insane last summer. The portraits in the first series have been taken by various photographers. It may not be out of place to say that the only instruction given to the patient or to the person in charge was to get a cabinet-size portrait, with direct front view, and to see that the photographer did not retouch or in any way change the negative. Hence there has in no instance been any posing for effect. The second series was made by Dr. P. M. Wise, Superintendent of the Willard Asylum.

It is greatly to be regretted that several of the most striking of the portraits of both series were destroyed by the fire which recently consumed Mr. Bierstadt's establishment while photo-engravings were being prepared from them. Both the negatives and the only existing copies of the photographs were lost.

The portraits in the first series are mostly of young persons, whose features are plastic and susceptible to favoring influences. In the other group the faces are those of older persons, whose features are less impressible; even in these very marked changes are observed.

The striking alterations of expression shown in these portraits are all the result of relief to the tension of certain of the ocular muscles by relaxation of some one or more of them by tenotomy. They show not only remarkable improvement in health, but to one who studies them attentively they exhibit certain characteristic attitudes and expressions of face which have never been accounted for, but the reasons for which become obvious when studied in this relation.*

* A number of these photographs are to be published, in connection with the English version of the author's memoir presented to the Royal Academy of Medicine of Belgium in 1883, by D. Appleton & Co.

No. 1 of the first series represents a child, ten years of age, who from infancy had been the victim of headaches. She was feeble, always tired, and rarely free from pain. Attempts to send her to school had proved unsuccessful, for she no sooner attempted attendance than she became prostrated. Under the influence of atropine, hyperopia 0·75 D. was found. She had insufficiency of the externi, 4° with abducting power of 4° (prism). The operation for its relief was made for one eye June 8, 1883, for the other June 12th.

It is needless to tell one who examines these two pictures, taken with an interval of twelve days, that the change was marvelous. The weary, heavy, discouraged aspect of the child, as shown by the portrait of June 8th, is in remarkable contrast with that of June 20th, when vivacity and courage are embodied in her expression. The child returned home to enter school, where she has done excellent work.

The portraits of No. 2 are even more strikingly in contrast, and the history of the case is one of very great interest.

J. B., aged fifteen, was brought for examination, by the advice of Dr. A. H. Allen, on April 17, 1884.

She was in early childhood an intelligent, and in most respects a healthy, child, subject only to nervous attacks. At the age of twelve she became an epileptic, subject to attacks from three to five times a day, which were characterized by severe convulsions and unconsciousness, and lasting from ten to thirty or more minutes. In addition to these severe attacks, the milder seizures of *petit mal* occurred many times a day. Evidences of the deplorable effects of the disease upon the girl's mind were soon manifest. She became dull, morose, and feeble-minded, losing from month to month the vivacity which had characterized her in earlier years. After making use of such means for relief as were suggested by several competent physi-

cians with little or no favorable result, her parents were induced, a year before her first visit to me, to administer in large doses a secret preparation, which proved to be mainly a saturated solution of bromide of ammonium. Dementia, under this treatment, became the most pronounced feature of her disease. The fits were less frequent, and, indeed, were at one time absent during several weeks. It was known, however, that failure to administer the drug for a day or two would be followed by a renewal of the attacks, and, during the two months preceding her visit to me, notwithstanding the use of six drachms of the solution daily (about two hundred and forty grains of bromide), the fits had returned in nearly the former frequency. The face was devoid of any expression of intelligence, and saliva flowed from the angles of her mouth. When attempting to speak in monosyllables, the voice was smothered in the fluids of the mouth. Indeed, the patient presented a typical picture of marked dementia. Her attendants believed that she did not see well, and, as nearly as could be ascertained, there was slight myopia with $\frac{20}{40}$ vision. The eyes being brought under the influence of atropine, the ophthalmoscope revealed hyperopia 1·50 D. There was an appearance of decided insufficiency of the externi, but there was too little intelligence on the part of the patient to admit of any determination by the equilibrium tests. The bromide solution was discontinued at once, and a little wine was administered two or three times daily, and convex glasses, 1·00 D., were used. Under this regime some improvement in the mental and physical condition could be observed after the first week. The fits, however, became more frequent and severe in proportion to her recovery from the influence of the drug. Thus, during the week ending May 3d, there occurred fifteen fits, in each of which unconsciousness continued from ten to thirty minutes. During the week ending May 31st there were twenty-nine very severe attacks, and attacks of *petit mal* in great numbers. By the 29th of May, after almost daily trials, it was hoped that some progress had been made in the knowledge of the relations of the eyes, and it was supposed that an insufficiency of the externi of from 10° to 30° at twenty feet existed while using the convex glasses.

With a clear understanding, on the part of the girl's father, of the difficulties attending the determination of precise conditions under the circumstances, and with his full approval, an operation for insufficiency of the externi was done on the right eye June 4th, and two days later a similar operation on the left, after which the appearance of the eyes was improved, and little, if any, insufficiency was shown by the tests, such as could be made. Going back a few days:

June 1st.—She had five fits.

2d.—She had seven fits.

3d.—She had five.

From June 4th (the day of the operation) to *June 14th no attacks occurred.* From June 14th to June 31st she had eight attacks. June 21st to June 28th, three attacks, all of which were unusually light. No *petit mal* since June 4th. On July 7th she returned home, her last attack having occurred June 25th. The change in her mental condition had been, since the operations, truly marvelous, and her physical condition had equally improved. From time to time the patient has been seen. She continued in robust health, and her intellect returned. An attempt to send her to school some months after her return home was followed by a very slight relapse, but her friends were advised to wait a year before allowing her much close use of her eyes.

She was last seen September 12, 1885, when she was well.

A letter from her physician a few months since reported her still well.*

No. 3 represents a lad with chorea, and exhibits the ocular conditions fairly well. There was myopic astigmatism of 0·75 D. in each eye, with insufficiency of the interni 5°. Tenotomy of the externus of each eye was followed by very marked relief. He had still a considerable tendency to deviation of the eyes in the vertical line, which,

* Since this paper was read, I have heard that the patient has suffered a relapse. If the report is true, of which there is a doubt, it indicates that the ocular trouble has not been completely removed.

from failure to relieve, continued the irritation in a degree. He has been able, however, to go on with his studies for two years with only occasional trouble. When last seen a few months since he was nervous from over-study, and there were ocular disabilities quite sufficient to account for his trouble.

No. 4 represents a young lady who had been two years an epileptic. Great relief followed the relaxation of the interni, which was done in December, 1884, but from time to time at long intervals the malady has continued to manifest itself. Recently it has been found that a condition of hyperphoria,* which was almost totally latent, existed, and an operation for the relief of this has been attended thus far with very happy results, so far as a general relief from a sense of vertigo, which had continued, is concerned. It is hoped that this may complete the relief, which has already been very great. The portraits exhibit a very marked improvement, but less than has actually taken place in the condition and appearance of the patient up to the present time.

No. 5. Miss M., aged twenty-nine. Subject to epilepsy and chorea from the first year of her life. Epileptic attacks from three to five times daily. Occasionally the fits were of great violence, but usually last only a few minutes. Has never since

* The term *hyperphoria* is employed in the absence of any other single term to express a tendency less than strabismus of a visual line in a direction above its fellow. Thus, "right hyperphoria" signifies that the visual line of the right eye tends in a direction above the direction of the visual line of the left eye, without implying that the line to which it applies is too high, but that it is higher than the other, without indicating which may be at fault. See "New York Medical Journal," December 4, 1886; "Archives d'ophthalmologie" (Paris), November, 1886.

All tests for insufficiencies of the muscles of the eyes were made at twenty feet.

her first year taken objects in her left hand, that side being most affected by chorea. The left elbow is drawn forward and strongly against the chest, the hand turned palm outward, backward, and upward. The left arm and in less degree the whole body are in constant and violent motion. If an attempt is made to bring the arm into its normal position, the whole body becomes convulsed, the face distorted, and both arms move wildly. The visual anomalies were hyperopic astigmatism, right eye, 1·00 D.; hyperopia, 1·00 D., left; insufficiency of the externi, amounting to diplopia of 5° when red glass was used, and hyperphoria, 2°. The hyperphoria and astigmatism were treated with cylindro-prismatic glasses. Tenotomy of one internus was done under great difficulties, owing to the patient's mental state, November 22, 1884, and of the other, January 3, 1885. Great relief followed the first operation, and the fits ceased from the 1st of December. In a month she was able to use the left hand for the first time in twenty-eight years to a considerable extent, and delighted in showing how she could brush the windows of the consulting-room with a napkin. Her intellect improved, and, as will be seen by the portraits, her head came to the normal position, and her appearance in every respect was better. Up to April 20th, when the last record was made, there had been no return of epilepsy. I have, however, learned that during the summer the fits returned in less frequency and degree. A recent letter from her sister informs me that it is the purpose of her friends to pursue the treatment which resulted so favorably still further as soon as circumstances allow.

No. 6. Miss M., epileptic six years. The position of the head is an excellent illustration of one of the characteristic positions of the head as the result of hyperphoria. The superior rectus of the right eye was relaxed, March 4, 1886. The fits ceased, and the patient's general condition greatly improved, as is shown by the remarkable contrast in the portraits. I have recently learned that the fits have returned. Beyond a doubt a considerable degree of hyper-

phoria would now be found, which should be relieved. This condition is extremely liable to remain in great degree latent, and to become manifest some months after a full correction is supposed to have been made.

No. 7 represents an interesting case of chorea which had continued during the life-time of the patient, a boy of sixteen. The boy was feeble-minded and incapable of learning. His whole body was in perpetual motion. This is well shown in the photograph taken April 28th, when, notwithstanding the rapidity of modern photography, it was quite too slow to get a clear picture. The shaded borders of the picture show the movements of the head. The same shadings are seen in the first picture in No. 5. The boy had hyperopia 2·50 D., and insufficiency of the interni to the extent of producing, much of the time, homonymous diplopia, which was shown when a red glass was placed before one of his eyes, when the refractive error was corrected. Tenotomy of the left internal rectus was done April 28, 1885, and of the right, May 6th. The change in the boy's condition was marvelous. I am sure that one of the gentlemen who is present to-night, and who saw the boy at the time of one of the operations, will confirm the statement that the photographs do not exaggerate the improvement, nor even adequately represent it. He has had no chorea up to the present time, but when he recently visited me I discovered hyperphoria, which I hope to remove.

No. 8 represents a most remarkable change in the condition of an insane young man. The history of the case is as follows:

The patient was brought to me by his parents bearing a letter from Dr. Wise, Superintendent of Willard Asylum. According to the history given by the parents, October 12, 1886, the boy had been insane a year and ten months (according to the

report of neighbors, much longer). During a season of unusual religious interest the boy became unquestionably insane. His condition was gradually more and more hopeless until his friends determined to commit him to the asylum. It was when at this institution that they were advised by Dr. Wise to take the patient to New York. When first seen he was stolid, refusing to speak, and sadly demented. He wept aloud and wrung his hands much of the time. He refused food, and indeed for many months had only taken it as it had been placed in his mouth by others. If standing, he held his arms out in an imbecile manner with the fingers spread apart. The saliva flowed in streams from his mouth to the floor. He was thin and pale, and a cold moisture covered the skin. In this pitiable condition it was difficult to obtain exact information of the ocular conditions, but by the exercise of much patience these conditions were sufficiently made out to enable a generally correct judgment to be formed. Under atropine he showed hyperopia 1·00 D., with insufficiency of the externi 4°. On the 14th of October the first photograph was taken, and on the same day a tenotomy of one of the internal recti was done, and two days later a similar operation was made on the opposite internus. From that day an improvement could be seen in the lad's mental state. Within a week he was so much improved as to amaze those who had seen him in his first condition. He soon began to take food of his own accord, and in two weeks he was in a fair way to complete recovery. On November 2d the second photograph was taken, eighteen days after the first, and three weeks from the day of his first visit he returned to his home, no longer insane. His friends were advised to bring him again after a few weeks, which they wisely did. Slight hyperphoria was then found, and a tenotomy of one of the superior recti was then done. When he returned home the second time he was, so far as could be detected, perfectly well.

The photographs show more than I am able to tell, but even they do not convey a perfect idea of the wonderful revolution which had taken place in the mental and physical condition of the boy in eighteen days.

Dr. A. L. Ranney has very kindly permitted me to add

to the photographs of my own cases those of one of his. The pictures represent a young lady who had been for many years an epileptic and for whom he has wrought a most salutary change by relief to the ocular muscle strain. Dr. Ranney tells me that the young lady has remained well during seven months, notwithstanding she had been subject to convulsions, amounting frequently to ten or more in a day. The portraits speak for themselves. The young lady has undoubtedly improved in a remarkable manner, and we do not need his testimony, that the epilepsy has ceased, to recognize the fact of her improvement.

The illustrations thus far have been drawn from my private practice. Those which follow are from cases treated in a public asylum. During the last summer I spent four weeks at a summer hotel in the vicinity of the Willard Asylum for the Insane, and, at the request of the superintendent, examined and treated several of the patients, fourteen in all, twelve of whom were insane epileptics, one an out-door patient, a cataleptic, and one a non-epileptic maniac. I visited the asylum frequently during the four weeks, spending about two hours with the patients at each visit. It is proper to remark that this institution is designed as an asylum for incurables, its inmates consisting principally of insane persons who have already spent considerable time in other asylums where acute cases are treated, and who have been sent here in order to make room for more hopeful subjects.

In correspondence with Dr. Wise previous to taking charge of these people, the wish was expressed by me that only such cases should be selected as were, in his judgment, typical cases of epilepsy of the insane and by ordinary methods absolutely incurable. The more frequent the attacks and the longer the duration of the disease, the more desirable would be the case. Intelligence enough to read printed letters and to answer very simple questions was considered

desirable. Of the fourteen patients selected, all except the cataleptic case were in a condition of more or less profound dementia, twelve were cases in which very frequent attacks of epilepsy were associated with more or less frequent paroxysms of frenzy, and all of these were cases in which both insanity and epilepsy had existed during many years. The average length of time of attendance upon these patients was a little more than two weeks.

Dr. Wise kindly promised me he would furnish me with a preliminary report showing the condition of these people a month after the conclusion of my attendance, and that another more complete should follow after several months. The first of these came to hand in October last. The other has not been received, and I have no report of the condition of these patients, with a single exception, since that time. I shall not attempt to give Dr. Wise's report in full, but will furnish a few extracts from it and give its substance. Dr. Wise reports:

"Case I.—F. C., aged twenty-six. Admitted February 6, 1885, with a history of epilepsy of sixteen years preceding admission. She has almost daily attacks of *petit mal* and occasionally severe fits. She has alternate periods of excitement and depression, when she is suicidal and has made several attempts to destroy herself. She is discontented, but usually she is quiet. On July 7th all medicine was stopped and a record of her convulsions kept. The following is copied from the record. July 7th, two light convulsions; 10th, one convulsion, light; 11th, one convulsion; 13th, one severe, two light convulsions; 15th, one; 16th, one; 18th, three, one severe and two light; 20th, three convulsions; 21st, one; August 2d, one; 7th, one; 9th, five severe convulsions. The first operation was made August 3d, and final August 12th. [The operations were for hyperphoria, by tenotomy of a superior rectus of one eye and afterward of the inferior rectus of the other eye.—G. T. S.] Subsequently to the last operation she had a severe convulsion on

August 20th, and none later, with the exception of a *petit mal* on September 9th within the thirty days following the final operation."

In other words, she had twenty-three convulsions for thirty days preceding the operation, and two for the thirty days following it.

"Her general health has improved, and Dr. Bristol, her attending physician, reports: 'She is less irritable and fault-finding, and has not suffered from depression in the same degree as formerly.'"

Of the report of

Case II I give only a summary. Woman aged fifty-two, epileptic fifteen years, insane many years. Bromides stopped July 9th. During the next thirty days she had fifteen convulsions. Tenotomy of superior rectus was made for correction of 2° hyperphoria, and during the thirty days succeeding the operation there were seven convulsions.

Case IV was an interesting one, as belonging perhaps to the most utterly hopeless class that could be selected. It was about a week from the time that his name was given me as a bad epileptic case before he was able to leave his bed, as he was in a constant state of epilepsy. When finally he was seen he was pale, his skin cold and moist, his face utterly expressionless, the saliva ran from his lips, and he presented the most pitiable spectacle of dementia. In making ocular tests, I supported his chin in my hand as the only means of maintaining any approximation to an upright position of the head. No very marked refractive anomalies were found, but a tending of one visual line above the other constituted the principal ocular defect. The operation was for the correction of hyperphoria of 3° by tenotomy of a superior rectus. I quote from Dr. Wise's report: "A. C., male, aged twenty-four. Second admission to asylum, February, 1886. Has frequent epileptic attacks and occasional status epilepticus. Is frequently violent, turbulent, and noisy. From July 14th to 16th he was excited and confused. He had two convulsions on July 21st, three on the 23d, two on the 24th, two on the

25th, two on the 29th, four on August 1st, four on the 3d. Then followed a period of confusion and excitement lasting several days. He again had two convulsions on the 12th and three on the 13th of August. His bromide of sodium was stopped on August 11th. On the 14th he was operated upon. From that time until September 23d (forty days) he was not observed in a convulsion. His mind became brighter, and he seemed to appreciate his condition and surroundings. From that time to date he has been in a status epilepticus, but is now improving. Dr. Blaine, his attending physician, considers that his eyes have reverted to their former position from which they were relieved by the operation."

Here we have doubtless another instance in which manifest hyperphoria having been relieved, that which was latent afterward became an element of trouble.

Time will only permit me to present one other case of this group in detail. I condense from notes given me by Dr. Allison, the attending physician, and from Dr. Wise's report:

"M. L., female, aged thirty-six. Insanity commenced seven years previous to present record. Subject to epilepsy for an unknown period; certainly longer than the period of insanity. About once a month she is taken with a series of epileptic seizures varying from three to eight or more, and at these times is liable to become greatly excited, depending apparently on the number of convulsions. A period of great exaltation and frenzy follows, during which she is furious, sings wildly, and shouts at the top of her voice, and is exceedingly destructive and violent. The paroxysm may last several weeks. When it has subsided she is orderly, neat, and industrious usually, until another series of convulsions occurs. She was first seen by me July 31, 1886. Examination of the eyes showed, with atropine, hyperopia, 4·00 D.; right hyperphoria of from 2° to 3°; and insufficiency of the externi of 4°, with abduction of 4°. Glasses for the correction of the refractive defect were furnished, and tenotomy of the right superior rectus and of the left internal rectus was

made. The final operation was made August 22d. Bromides, which had been previously freely administered, were withdrawn July 31st. August 26th, four days after the last operation, a period of moderate excitement, very much less than usual, commenced and continued until September 12th. On January 2, 1887, more than four months after the ocular treatment, Dr. Allison wrote concerning Miss L.: 'She has not thus far had any attacks of maniacal frenzy and only one attack (the one above mentioned) of excitement, which was not great. She says she has not had any convulsions; she is very much improved, and feels very grateful.'"

Taking conjointly Dr. Wise's report and my own notes made at the asylum as a basis of reckoning, it would appear that among the ten epileptics in whom ocular tests could be made there occurred during the month preceding the operations upon the eyes about one hundred and seventy convulsions, besides several periods of status epilepticus. During the month following the operations there occurred to the same persons about forty epileptic attacks and two conditions of epileptic status. In other words, there was more than four times as much epilepsy among these ten during the month preceding than in the month succeeding the operations, notwithstanding the withdrawal of bromides.

When it is remembered that the time during which attention was given to the ocular conditions was less than the average time usually given by physicians to comparatively trifling affections, these results must be considered not only remarkable but absolutely unique.

It will be asked, in what proportion are we to expect good results from attention given to ocular conditions in nervous diseases? Taking epilepsy, which is undoubtedly one of the highest manifestations of nervous disturbances and certainly one of the least curable of diseases by medication, I find the following results: Of sixty-four consecu-

tive cases of well-marked epilepsy in private practice, of which in every instance the disease had been of more than one and in most of many years' duration, and in all of which the treatment has been directed to ocular conditions, medicines having been, except in a single instance, discontinued, thirty-two have remained free from attacks for a time varying from several months to several years*—a time which would in all ordinary conditions enable us to regard the cases as well. Twenty-one have shown under this treatment such marked improvements as to indicate with certainty that the ocular conditions and the disease were in relation as cause and effect. In some of these cases the change has been very remarkable, but short of absolute relief. In eleven cases no improvement has occurred, or, if any, of only a temporary character. Thus, without the employment of drugs to destroy the nervous susceptibility to irritating causes, 50 per cent. of these patients are, so far as can be known, well; another large proportion much better off than when using bromides, while only 17 per cent. show no improvement.

Are we to conclude that in one sixth of these cases the ocular conditions have no relations to the disease? I am sure that we are not. A better understanding of the means of forming a judgment in this respect will be had if it is stated that, so far as my experience goes, epilepsy very rarely results from simple conditions. The ocular anomalies in epilepsy are of the most complicated and often of the most obscure character. A simple insufficiency may induce headache or other minor manifestations, but the ocular causes of epilepsy are usually of a character most perplexing to the surgeon, and sometimes of a character which can not be completely remedied. Hence great pa-

* Several of these patients have remained well for a period of from five to seven years.

tience and, in certain cases, much time and skill are required to accomplish that which can finally be done. If in the mean time the patient and his friends are constantly assured by both lay and professional advisers that his efforts must of necessity prove fruitless, he is apt to withdraw from treatment even while defects of great importance are known to exist and which by continued effort might be removed.

Again, the extremely complicated state of muscular anomalies in epilepsy has, in my own experience, led to procedures which have resulted in new anomalies quite as mischievous as those which it was hoped to remove. A larger experience and a better knowledge of these complications are, as I believe, helping me to avoid some of these accidents; but it is to these in several instances that the failure of success is to be attributed.

It is reasonable to inquire whether results obtained in this way are permanent. In reply to this it may be said that they are permanent in proportion to the extent to which the irritating cause is removed. In this respect relief to anomalies of the ocular muscles obeys the same law as governs in anomalies of refraction. The young person who corrects a manifest hyperopia obtains relief from asthenopia for a time, but when after a while the trouble returns he is relieved by further correction of that which has since become manifest. Or, better still, by means of certain agents his absolute hyperopia is discovered at once and proper corrections are made from the first. This is not at present possible in excessive tensions of the long muscles, and we must wait for time to enable us to form a correct judgment whether the whole defect has been removed. A sudden and marked relief to a serious and obstinate nervous trouble after a removal of an anomaly of the ocular muscles is sufficient to indicate that the reason for the malady has

been found. If a relapse occurs after many months, it is quite reasonable to look in the same direction for the cause of the renewal of the trouble.

The president has kindly requested me to state to the society how much of importance I attribute to this class of conditions, and also to give a summary of my methods of procedure in examining for them and in treating them. I will endeavor to give in as short a space as possible an outline of a reply to both inquiries. Respecting the importance to be attributed to ocular, refractive, and muscular anomalies, I fear that my views will for some time to come continue to be regarded as something more than radical; but I am ready to reaffirm the proposition made years ago, that, among the various elements constituting the neuropathic tendency, these anomalies must be regarded as occupying a pre-eminent position.

Summing up the experience in this field of work, it is shown that, not in occasional and rare instances only, but in a large proportion of cases of the most redoubtable neuroses, unusual and most salutary results may be anticipated from attention directed to visual troubles. The accuracy of this statement is fully confirmed by the portraits which have been exhibited here, and which clearly show that the disease has not been suppressed. The relief is the legitimate result of the removal of an adequate cause, and the patient, under such circumstances, at once rises into a physical and mental condition greatly in contrast with that which results from the prolonged methods of suppression, such as brominism or other similar means.

While wishing to emphasize the importance of these experiences, may I not be pardoned for repeating the statement that it is not intended in any way to underestimate or to forget other causes of irritation or exhaustion, or the propriety of searching for and of removing them?

The principle of ocular irritation is of wide application, and is not to be compared with the occasional irritation set up by such accidental and usually secondary causes as phymosis, the presence of calculus, the existence of a stricture of a passage, the effects of decayed teeth, and of many other peripheral irritations which might be mentioned. All these are of importance and are not to be overlooked.

The conditions to which I have especially called attention are, however, in general, commensurate with the life of the patient and exist in a vastly greater number of instances than either or all of the conditions belonging to the other class just mentioned. Not only are those painful or irregular conditions usually described as neuroses in great proportion responsive to the relief from ocular tensions, but a great variety of conditions commonly regarded as local affections yield as readily, and prove that with some possible local complications they are in fact reflex phenomena. As an instance of this class of troubles, I may mention the fact that in more than a score of cases of extreme dysmenorrhœa—in each of which the periodical suffering has been of intense character, of regular occurrence, and of the full duration of the menstrual life of the patient—the dysmenorrhœa has failed to occur after relief to the tension of a superior or inferior rectus.

These experiences have been confirmed by the observations and practice of others. Among these, Dr. A. L. Ranney, who has made many careful observations and has had much success in the treatment of many of the most important neuroses, has assured me that cases of epilepsy of long duration have, under treatment directed to ocular difficulties, been scarcely less tractable than diseases commonly regarded as easily curable.

The discussion of the method of examination and treatment must of necessity be in outline only. In respect to

examinations for refractive anomalies I have nothing here to suggest. In respect to muscular anomalies, however, there is much more to be said than can even be touched upon here.

First let me suggest that the methods of determination of muscular anomalies taught by Graefe, Horner, and Nagle can not be most successfully employed in the work directed to these nervous disorders. Graefe's Method No. 3 is a method for determining equilibrium of ocular muscles by which it would be but rarely safe to perform an operation for the relief of a supposed deviating tendency.

In articles which appeared in a recent number of the "New York Medical Journal" and in the "Archives d'ophthalmologie," I have made general suggestions for making these determinations. For the purpose of going more into detail, I shall ask to be allowed to go over a part of the same ground.

The head being exactly in the primary position, the patient directs the eyes to an object, preferably a lighted candle, situated at twenty feet and directly in the median line. Diplopia (if the patient has binocular vision) is then produced by means of prisms. First of all, and the order of making the various tests is important, homonymous diplopia is induced by placing the prism with its base toward the nose. For convenience and accuracy in making this test, I have had made for me several pairs of spectacles containing, in each side, prisms of equal grade, of 5°, 6°, and 7°, with their base in. The glasses are quite long and in the form of a parallelogram, in order that their exact position on the face may be accurately known. In order that the head may be maintained in the exact position desired, I employ a photographer's head-rest. Double images appearing, if one is seen to be higher than the other, it is to be ascertained what degree of prism with its base up or

down will bring the two to the same plane. A difference of one half or even one third of a degree in this direction is of much importance. When the determination is made, it is, if a difference in plane is found, recorded as right or left hyperphoria. A prism of 6° or 7°, or of higher grade if necessary, is then placed in the trial-frame with its base exactly down or up, and tests similar to those described by Graefe for the dot-and-line method are made. The deviation of the images from a vertical line, if a deviation exists, is determined by the degree of prism required to correct, and also the full degree of correction which will be tolerated. The result is recorded as esophoria or exophoria. Beginning next with a moderately high grade of prism (8° or 9°), it is placed with the base in and the patient is required to tell whether diplopia is caused. If so, a weaker and weaker glass is used until he can blend the images, and the result is recorded as the amount of abducting power. The abducting power is next to be tried which may require the use of several prisms.

I can not accept the method introduced by Nagle and adopted by Landolt, in his recent superb work, of reckoning the abducting and adducting power as only negative and positive elements of the same act of convergence, and of adding them together as so much convergence. The abducting power is a subject for special examination and should never be confounded with the adducting power. This latter may well range from 40° to 70°, or even more. For many years I have adopted as the best standard of adducting 50°, but one who can overcome prisms of 50° will generally do much more—60° or 70°.

And all this is within the limits of easy convergence. On the other hand, the power of abduction should be confined within very strict limits. My own standard has for twelve years past been 8°. Two or three degrees less

than this is an unfavorable condition, and more tends to the suspicion of insufficiency of the interni. Hence, where on the one hand a variation of from ten to twenty degrees is of no account, and on the other a departure from the proper standard of a single degree may be of very great consequence, we are not to consider the two conditions as one.

Of the anomalies found by these examinations I regard that which I have called hyperphoria as of by far the greatest importance. Here a single degree of deviation from the equilibrium may be a source of greater perplexity than 10° or 15° of insufficiency of the interni.

It is impossible to go into all details of questions of dealing with the deviating tendencies which may be found by these examinations; a general statement may, however, suffice to obtain for it the disapproval of many conservative persons. Treatment of muscular deviating tendencies by means of prismatic spectacles is neither satisfactory nor frequently successful. I do not mean that success is never attained, but that in much the largest proportion of cases it can not be attained by such means. Again, such spectacles are not curative, and it would be a mistake to condemn a patient, who did not otherwise require glasses, to their use for years, when a much more complete relief could be accomplished with scarcely an inconvenience of a day.

This, however, is too large a subject to discuss here, and I shall at once proceed to describe the method of performing tenotomy of the ocular muscles in case of deviations less than strabismus.

[Here followed a minute description of the speaker's method, which will appear in another connection. In the main it consists of making a small opening through the conjunctiva, exactly over the insertion of the tendon, when the tendon is seized by extremely fine forceps, and divided in each direction, preserving the extreme outer fibers, or, at

least, the reflection of the capsule of Tenon, which serves as an auxiliary attachment.]

I think it not unreasonable to look for the future advance in medical practice along two great lines. That advance along one of these lines was begun when Jenner, recognizing the fact that the human subject may be made sterile to the development of certain organisms when once it has been preoccupied by the presence of the same or a similar class of organisms, introduced vaccination as a preventive of one of the greatest scourges of the race. In our day an army of investigators, well trained and well equipped, is exploring the realms of the minute in search of the micro-organisms which, in their invasions in swarming myriads within the human body, threaten or destroy it by their devastations. It is not impossible that, against the inroads of the various organisms whose incursions constitute typhoid and typhus, scarlet fever and measles, cholera and yellow fever, barriers may be erected which shall in large measure protect against that class of maladies which now destroys so large a proportion of the population of the world. The advances which have already been made along that line are, doubtless, but the earnest of that which is to come.

Along the other line we may look for as great achievements. The class of maladies which has been during all time relegated to the tender mercies of fetichism and superstitious notions of cures by drugs having no relations to the origin or the nature of the disorders themselves, will ere long be regarded as irregular phenomena resulting from well-defined causes of irritation, which causes must be sought for principally in the direction of difficulties in the performance of necessary functions. With the removal of such difficulties we may look with confident expectation to the cessation of the peculiar irregularity which constitutes the

special form of nervous disease. Through such means we may reasonably expect that the great class of functional nervous troubles of which epilepsy and insanity, neuralgia and hysteria may be regarded as representatives will be nearly as effectually guarded against as is small-pox by vaccination. And not only will the relief to such disorders be sought in the removal of an irritating cause, but, as in vaccination precautionary measures are taken before the subject has been exposed to immediate danger, so will the working organs be tested in respect to their working capacity in order that every disability may, so far as it is possible, be removed. Principal among these testings will be that which relates to the organs of vision. The child who enters school will, before the organs upon which he is to depend for his advancement in study are exhausted, and perhaps permanently injured, be examined, and provision will be made that he may not be required to contend against needless frictions and difficulties. Such examinations will not be of the perfunctory sort which one may make by directing the subject of examination to read the letters upon a trial-card, or which the examiner may make by a glance through an ophthalmoscope. That a thorough system of examinations of the visual organs, pursued as universally as the practice of vaccination, attended by the precautionary measures which would thereby be seen to be required, would reduce the prevalence of nervous affections in a surprising degree, I can not for a moment doubt.

If it be said that the origin and prevention of nervous diseases is to be found in a great variety of circumstances, I reply: let us find them all, and adapt our measures to them all; but let us not neglect this because there may be others.

For myself, I do not think that another as important class of causes of nervous disturbance will be found as that

which attends the anomalies of the parts engaged in the performance of the visual function. In any case, our aim is to prevent the evils of nervous derangement by the early removal of any known mischievous tendency, and our duty is, when such nervous derangement actually occurs, to remove every perplexing cause. In the observance of such a principle we may leave to superstition and to ignorance the practice of expelling nervous diseases by means either fashionable or obsolete.

"EYE-STRAIN"

IN ITS RELATIONS TO NEUROLOGY.*

Following the exhibition of a series of photographs of cases which have been shown this evening, it seems to me that little needs to be said in confirmation of the views advanced by Dr. Stevens. These photographs are so startling that they would be accepted, in my opinion, in any court of justice by an unprejudiced jury, as proof that unmistakable benefits had been derived from the treatment. They are from untouched negatives, made with no collusion between the patient and the doctor, or the doctor and the photographer. They tell their own story in a simple way, which needs no comment from me. I have personally seen and examined several of these cases, and I consider the published histories as decidedly understated.

As I have been specially invited, both by the author of the paper and by your esteemed president, to give my views here this evening, it may not be inappropriate for me to state that I have performed the Stevens operation for the

* This paper comprises the substance of my remarks made before the Neurological Society of New York, in the discussion which followed the paper prepared by Dr. George T. Stevens, of New York, entitled "Irritations arising from the Visual Apparatus considered as Elements in the Genesis of Neuroses," and read by invitation before that society, on March 1, 1887.

relief of ocular insufficiency nearly two hundred times, and have carefully observed the condition of refraction and accommodation, as well as that of the ocular muscles, in several hundred subjects afflicted with various forms of nervous diseases. In the tests made I have followed very closely the methods employed by the author of the paper of the evening.

I desire to say here that I do not pretend to speak as an oculist, but as a neurologist. I am not here to discuss the points that may be raised by the ophthalmologists present. I have simply learned (as every neurologist should do) the details of a method designed for the purpose of diagnosis and treatment of refractive and muscular anomalies, and I have uninterruptedly followed that method in nearly every case seen by me in my office for the past two years. I can here state that originally I was a skeptic. My skepticism, however, became no longer tenable when I saw a choreic and epileptic imbecile in Dr. Stevens's office, who was perfectly restored in a short time to health and mental sanity by the method described by the author of the paper of the evening.

I think this paper will tend to establish *a new era in neurology*. For the treatment of functional nervous disease I should feel myself unfitted to-day without my case of trial-glasses and prisms.

In reference to the *operation* described, I would remark that in no case have I observed any bad effects as the result of surgical interference, or complications which have caused me any anxiety. This line of treatment requires a careful regard for detail, accurate records of all observations made, and special skill derived from experience and close observation to insure satisfactory results. If properly followed, I know of no line of treatment which has yielded such startling results in functional nervous dis-

cases. If employed by a novice, it is not hard to understand how serious difficulties might arise.

Respecting the view that the *eye* is an important factor in creating and prolonging the so-called "*neuropathic predisposition*," the following facts are pertinent:

1. No one has yet shown in what this predisposition lies; hence, if Dr. Stevens has shown that eye-defect is an important element in these conditions, a great advance has been made.
2. There is no recognized pathology in functional nervous diseases.
3. Heredity is very common in these affections. It is one of the most marked features in this class of nervous diseases.
4. My records (in common with those of Dr. Stevens) go to show that eye-defect is found in a very large proportion of such subjects.
5. Many of the eye-defects found can be shown to be congenital—being inherited, like other facial peculiarities.
6. The manifestations of the neuropathic predisposition vary with each case. They are called forth often by extremely trivial circumstances. These are too frequently regarded as of great clinical interest.

In the treatment of the *severer forms of functional nervous disease* (for example, in a typical case of chronic epilepsy), one radical cure without the aid of drugs offsets a thousand failures as a proof of the scientific value of a discovery. Let us see how the paper stands in this respect:

1. Radical cures of epilepsy have been reported. In Dr. Stevens's experience seven patients have been free from epileptic seizures for more than five years, after tenotomy of the eye-muscles and without the aid of medication. Such a result can not be attributed by

fair-minded critics to the effect of chance or accident.

2. Dr. Wise's report of the work in the Willard Asylum (with the light thrown upon it by Dr. Stevens) is a remarkable record. In spite of the cessation of the bromides and all medicinal treatment, in twelve cases of chronic epileptic insanity the attacks were decreased over seventy-five per cent. during the month following the operations. No unbiased person can fail to see the great disadvantages which existed in treating the hopeless cases of those whose answers could not be relied upon when tests were being made, and whose treatment was of necessity crude and incompleted (Dr. Stevens's stay being of very short duration). It must also be borne in mind that an incompiete relief of ocular tension, made under such disadvantageous circumstances, would naturally be liable to be followed by relapses. If one patient so treated made a perfect recovery, it is the strongest evidence in favor of the necessity for operation.
3. My own experience in the treatment of epilepsy by this method has yielded very satisfactory results.

I have taken from my own record-book the following abstract of cases of epilepsy, treated by me in private practice during the past year and a half. Total number of cases = sixteen. In only two were both eyes emmetropic; in nine, hyperopia or hyperopic astigmatism existed; in five, myopia or myopic astigmatism was found. In only one case was no defect in the eye-muscles found. Insufficiency of the interni (*exophoria*) was not detected in a single instance. Esophoria and hyperphoria predominated. In nine, the mental powers were very markedly impaired. Of these sixteen patients, five refused operation; one was sent to an asylum; one, whose trouble was due to syphilis, recovered

under specific treatment; one was too young to make the tests sufficiently reliable to warrant surgical interference; and eight were operated upon by me. Of these eight, three are apparently cured and five are still under treatment. Two have had no fits for over one year. One of these averaged at times as high as ten seizures in a day before I operated upon the eye-muscles. In every one of the five cases still under my observation the attacks have been lessened, in spite of the fact that no medication has been allowed since the date of the operation. One patient has granular kidneys, and the four others bid fair to improve still further, if not to recover entirely. Photographs of one of these are shown you to-night with permission. This young lady is well known to some of the medical gentlemen who are present. She has enjoyed from time to time the skillful services of many of the best neurologists and oculists in this city, who have done all that science could do for her, except to divide her interni and left inferior recti muscles. After ceasing the administration of bromides some two years ago, she had seventeen severe attacks in one night.

One case of *neurasthenia*, with mental symptoms closely bordering on insanity, was completely cured by me through the relief of a high degree of insufficiency of the externi and the correction of a latent hyperopia of about two dioptres. Another subject of neurasthenia, with recurring attacks of severe gastralgia, palpitation of the heart, and frequent symptoms of impending suffocation of sixteen years' standing, is to-day apparently cured by tenotomy of the externi. For many years she had not been able to spend evenings in company, or often with her immediate family, on account of the excitement induced by so doing. She had more or less constant tremor, which immediately ceased after the operation.

In cases of *headache* and *neuralgia*, I have had some

very remarkable results follow tenotomy of the eye-muscles. I have never yet encountered a case of typical migraine in which some form of eye-defect did not exist.

In *chorea*, I have found that hyperopia and muscular defect in the orbit existed in a very large proportion of the cases examined by me. The externi have been generally insufficient, or hyperphoria has existed in addition to a refractive error. The interni have never been defective in any case which has come under my personal observation, as far as I can recollect.

In *hysteria* and *hystero-epilepsy*, I have had some very satisfactory results from tenotomies performed upon the eye-muscles. One patient, who could with difficulty get across a room when unaided, walked three quarters of a mile soon after a hyperphoria was corrected by a tenotomy of the left inferior rectus, and a free division of both the externi was performed. At first she was carried each day to my office by hired assistants; to-day she walks daily up and down five flights of stairs, in addition to a walk of from ten to eighteen city blocks.

In summary, I would present the following conclusions as the result of uninterrupted investigations in this field for the past two years or more upon subjects afflicted with nervous diseases:

1. I believe that eye-defect constitutes a very important factor in the so-called "neuropathic predisposition." It is not pretended that it is present in all cases.
2. In neurology the importance of this line of investigation is particularly marked in the so-called "functional" diseases.
3. I am satisfied that "latent" insufficiency exists in many cases, as well as latent hyperopia, which is to-day generally recognized. There are many indisputable facts which confirm this proposition.

4. We have no means of accurately determining, in any given case, the exact amount of abnormal tension which needs correction, as we can do in the case of latent refractive errors by atropine.
5. I believe that tenotomy of the eye-muscles by the Stevens method is a safe and satisfactory way of relieving abnormal tension if practiced by competent experts.
6. Prisms will not meet the requirements of many cases. I regard them, at best, as but a temporary makeshift.
7. A tendency to vertical deviations of the visual axes is of great clinical importance in nervous diseases.
8. Tests for the determination of muscular errors should be made at a distance of twenty feet, in case operative procedures are to be based upon the error detected.
9. The attitude of the head of the patient should be carefully regarded while making these tests. A headrest is of great value, in many cases, as an aid in making the tests.
10. Statistics show quite conclusively that the benefits derived from tenotomies performed upon the eye-muscles are permanent *when all errors are thoroughly rectified.* No case is to be considered as finally disposed of so long as muscular errors in the orbit are clearly shown to exist. If a relapse occurs, it is generally safe to presume that a renewed search will enable a competent observer to detect some errors which the patient did not exhibit when under observation. The existence of "latent" insufficiency explains how such relapses may occur.
11. It can be shown that repeated tenotomies do not impair the normal functions of the eye-muscles when

a proper interval is allowed to elapse for a firm union of the divided tendon to the globe.

12. I believe that a careful regard to the details of the Stevens method of examination and operation, a thorough knowledge of physiological optics, and a full record of the results of every examination made of a patient's eyes (combined with good common sense), will give equally good results in other competent hands as in those of its main supporters.